This key should allow you to understand why you choose the option you did (beyond just getting a question right or wrong). More instructions on how to use this key can be found here.

If you have a suggestion to make the keys better, please fill out the short survey here.

Note: This key is auto-generated and may contain issues and/or errors. The keys are reviewed after each exam to ensure grading is done accurately. If there are issues (like duplicate options), they are noted in the offline gradebook. The keys are a work-in-progress to give students as many resources to improve as possible.

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1. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{-72 + 77i}{5 + 3i}$$

The solution is $-3.79 + 17.68i$, which is option D.

A. $a \in [-18, -16.5]$ and $b \in [3.5, 5.5]$

$-17.38 + 4.97i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

B. $a \in [-15.5, -13]$ and $b \in [25, 26.5]$

$-14.40 + 25.67i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-6, -2.5]$ and $b \in [600.5, 602.5]$

$-3.79 + 601.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

D. $a \in [-6, -2.5]$ and $b \in [16, 19]$

* $-3.79 + 17.68i$, which is the correct option.

E. $a \in [-130, -128]$ and $b \in [16, 19]$

$-129.00 + 17.68i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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2. Simplify the expression below and choose the interval the simplification is contained within.

$$2 - 14 \div 3 * 11 - (20 * 17)$$

The solution is -389.333, which is option A.

A. $[-391.33, -387.33]$

* -389.333, which is the correct option.

B. $[337.58, 343.58]$

341.576, which corresponds to not distributing addition and subtraction correctly.

C. $[-341.42, -336.42]$

-338.424, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

D. $[-1181.67, -1176.67]$

-1178.667, which corresponds to not distributing a negative correctly.

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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3. Choose the **smallest** set of Real numbers that the number below belongs to.

$$-\sqrt{\frac{441}{7}}$$

The solution is Irrational, which is option B.

A. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

B. Irrational

* This is the correct option!

C. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

D. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

E. Whole

These are the counting numbers with 0 (0, 1, 2, 3, ...)

General Comment: First, you **NEED** to simplify the expression. This question simplifies to $-\sqrt{63}$.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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4. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\sqrt{\frac{858}{6}} + 2i^2$$

The solution is Irrational, which is option D.

A. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

B. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

C. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

D. Irrational

* This is the correct option!

E. Nonreal Complex

This is a Complex number ($a + bi$) that is not Real (has i as part of the number).

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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5. Simplify the expression below and choose the interval the simplification is contained within.

$$3 - 17^2 + 15 \div 10 * 13 \div 16$$

The solution is -284.781, which is option D.

A. $[-286.17, -285]$

-285.993, which corresponds to an Order of Operations error: not reading left-to-right for multiplication/division.

B. $[291.99, 292.52]$

292.007, which corresponds to two Order of Operations errors.

C. $[292.43, 293.37]$

293.219, which corresponds to an Order of Operations error: multiplying by negative before squaring. For example: $(-3)^2 \neq -3^2$

D. $[-285.3, -284.01]$

* -284.781, this is the correct option

E. None of the above

You may have gotten this by making an unanticipated error. If you got a value that is not any of the others, please let the coordinator know so they can help you figure out what happened.

General Comment: While you may remember (or were taught) PEMDAS is done in order, it is actually done as P/E/MD/AS. When we are at MD or AS, we read left to right.

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6. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$\frac{18 - 44i}{8 + 5i}$$

The solution is $-0.85 - 4.97i$, which is option C.

A. $a \in [-76.5, -75.5]$ and $b \in [-6.5, -4]$

$-76.00 - 4.97i$, which corresponds to forgetting to multiply the conjugate by the numerator and using a plus instead of a minus in the denominator.

B. $a \in [1, 3.5]$ and $b \in [-9.5, -8.5]$

$2.25 - 8.80i$, which corresponds to just dividing the first term by the first term and the second by the second.

C. $a \in [-1.5, -0.5]$ and $b \in [-6.5, -4]$

* $-0.85 - 4.97i$, which is the correct option.

D. $a \in [3.5, 6]$ and $b \in [-3.5, -2.5]$

$4.09 - 2.94i$, which corresponds to forgetting to multiply the conjugate by the numerator and not computing the conjugate correctly.

E. $a \in [-1.5, -0.5]$ and $b \in [-443, -440]$

$-0.85 - 442.00i$, which corresponds to forgetting to multiply the conjugate by the numerator.

General Comment: Multiply the numerator and denominator by the *conjugate* of the denominator, then simplify. For example, if we have $2 + 3i$, the conjugate is $2 - 3i$.

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7. Choose the **smallest** set of Real numbers that the number below belongs to.

$$\sqrt{\frac{11664}{144}}$$

The solution is Whole, which is option E.

A. Integer

These are the negative and positive counting numbers (..., -3, -2, -1, 0, 1, 2, 3, ...)

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3)

C. Irrational

These cannot be written as a fraction of Integers.

D. Not a Real number

These are Nonreal Complex numbers **OR** things that are not numbers (e.g., dividing by 0).

E. Whole

* This is the correct option!

General Comment: First, you **NEED** to simplify the expression. This question simplifies to 108.

Be sure you look at the simplified fraction and not just the decimal expansion. Numbers such as 13, 17, and 19 provide **long but repeating/terminating decimal expansions!**

The only ways to *not* be a Real number are: dividing by 0 or taking the square root of a negative number.

Irrational numbers are more than just square root of 3: adding or subtracting values from square root of 3 is also irrational.

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8. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(-9 - 8i)(2 + 7i)$$

The solution is $38 - 79i$, which is option A.

A. $a \in [38, 39]$ and $b \in [-79, -78]$

* $38 - 79i$, which is the correct option.

B. $a \in [-75, -69]$ and $b \in [-51, -46]$

$-74 - 47i$, which corresponds to adding a minus sign in the first term.

C. $a \in [38, 39]$ and $b \in [74, 83]$

$38 + 79i$, which corresponds to adding a minus sign in both terms.

D. $a \in [-75, -69]$ and $b \in [43, 53]$

$-74 + 47i$, which corresponds to adding a minus sign in the second term.

E. $a \in [-18, -15]$ and $b \in [-57, -52]$

$-18 - 56i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.

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9. Choose the **smallest** set of Complex numbers that the number below belongs to.

$$\frac{\sqrt{182}}{18} + \sqrt{-7}i$$

The solution is Irrational, which is option D.

A. Not a Complex Number

This is not a number. The only non-Complex number we know is dividing by 0 as this is not a number!

B. Rational

These are numbers that can be written as fraction of Integers (e.g., -2/3 + 5)

C. Nonreal Complex

This is a Complex number $(a + bi)$ that is not Real (has i as part of the number).

D. Irrational

* This is the correct option!

E. Pure Imaginary

This is a Complex number $(a + bi)$ that **only** has an imaginary part like $2i$.

General Comment: Be sure to simplify $i^2 = -1$. This may remove the imaginary portion for your number. If you are having trouble, you may want to look at the *Subgroups of the Real Numbers* section.

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10. Simplify the expression below into the form $a + bi$. Then, choose the intervals that a and b belong to.

$$(6 + 4i)(8 + 9i)$$

The solution is $12 + 86i$, which is option B.

A. $a \in [82, 91]$ and $b \in [-22, -19]$

$84 - 22i$, which corresponds to adding a minus sign in the second term.

B. $a \in [11, 18]$ and $b \in [83, 90]$

* $12 + 86i$, which is the correct option.

C. $a \in [11, 18]$ and $b \in [-89, -85]$

$12 - 86i$, which corresponds to adding a minus sign in both terms.

D. $a \in [82, 91]$ and $b \in [13, 24]$

$84 + 22i$, which corresponds to adding a minus sign in the first term.

E. $a \in [41, 51]$ and $b \in [33, 37]$

$48 + 36i$, which corresponds to just multiplying the real terms to get the real part of the solution and the coefficients in the complex terms to get the complex part.

General Comment: You can treat i as a variable and distribute. Just remember that $i^2 = -1$, so you can continue to reduce after you distribute.
